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Final Program

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Program

Electric Field Assisted Sintering and Related Phenomena Far from Equilibrium

March 6 – 11, 2016

**Hotel dos Templários
Tomar, Portugal**

Conference Chair

Rishi Raj
University of Colorado at Boulder, USA

Conference Co-Chair

Thomas Tsakalakos
Rutgers University, USA



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Sunday, March 6, 2016

16:00 – 18:00	Conference Check-in
18:00 – 19:30	Welcome Reception (Lobby Bar)
19:30 – 22:00	Dinner followed by Reception

NOTES

- Audiotaping, videotaping and photography of presentations are strictly prohibited.
- Speakers – Please leave at least 5 minutes for questions and discussion.
- Please do not smoke at any conference functions.
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Monday, March 7, 2016

07:30 – 08:30 Breakfast

08:30 – 08:35 Welcome – Conference Chairs

Introductory Remarks:
ECI Liaison – Lawrence Kabacoff

Session 1: Flash, Microwave, SPS and Grain Growth – I

Session Chair: Rishi Raj, University of Colorado at Boulder, USA

08:35 – 09:05 **Electric field–induced electronic conduction in bulk oxide ceramics**
Anthony R. West, University of Sheffield, United Kingdom

09:05 – 09:35 **Flash microwave sintering of oxide ceramics**
Kirill I. Rybakov, Institute of Applied Physics, Russian Academy of Sciences;
Lobachevsky State University of Nizhny Novgorod, Russia

09:35 – 10:05 **Flash sintering of covalent non–oxide ceramics at low temperatures with low DC electric fields: An *in situ* EDXRD study by synchrotron probe**
Thomas Tsakalakos, Rutgers University, USA

10:05 – 10:25 Coffee Break

10:25 – 10:55 **Field–assisted and flash sintering of nanocrystalline yttria: Densification and microstructural evolution**
Hidehiro Yoshida, National Institute for Materials Science, Japan

10:55 – 11:25 **Electroluminescence and Heating Rates during Flash**
Rishi Raj, University of Colorado Boulder, USA

11:25 – 11:55 **Highly transparent spinel windows by microwave sintering**
Jasbinder Sanghera, Naval Research Laboratory, USA

11:55 – 12:25 Coffee Break

12:25 – 12:55 **The influence of fields and dopants on grain boundary mobility**
Wayne D. Kaplan, Technion – Israel Institute of Technology, Israel

12:55 – 13:25 **Spark plasma sintering of a functionally graded material consisting of a high–alloyed CrMnNi–steel and varying Mg–PSZ content**
Sabine Decker, Technical University Bergakademie Freiberg, Germany

13:25 – 14:30 Lunch

Monday, March 7, 2016 (continued)

Session 2: Flash, Microwave, SPS and Grain Growth – II

Session Chair: Thomas Tsakalakos, Rutgers University, USA

- | | |
|---------------|--|
| 14:30 – 15:00 | Electrical conduction mechanism at high voltages and dielectric breakdown strength in bulk ceramic insulators
Gerold A. Schneider, Hamburg University of Technology, Germany |
| 15:00 – 15:30 | Oxygen vacancy formation due to DC electric fields during flash sintering in BaTiO₃
Takahisa Yamamoto, Nagoya University, Japan |
| 15:30 – 16:00 | Effect of electric field/current on liquid phase sintering
Jesus Gonzalez-Julian, Forschungszentrum Jülich GmbH, Germany |
| 16:00 – 16:30 | Coffee Break |
| 16:30 – 17:00 | Influence of an electric field on grain growth and sintering in strontium titanate
Fabian Lemke, Karlsruhe Institute of Technology (KIT), Germany |
| 17:00 – 17:30 | First stage in flash sintering of zirconia based ceramics
Paul Carry, SIMaP Laboratory, France |
| 17:30 – 18:00 | Effect of (external) electric fields on heterogeneous solid state reactions – Special role of grain boundary diffusion
Carsten Korte, Forschungszentrum Jülich GmbH, Germany |
| 18:00 – 18:30 | Coffee Break |
| 18:30 – 19:00 | Spark and plasma aided densification mechanisms during spark plasma sintering of ceramic powders
Rachman Chaim, Technion–Israel Institute of Technology, Israel |
| 19:00 – 19:30 | The modification of the temperature gradient in a large sample sintered by SPS
Mirva Eriksson, Stockholm University, Sweden |
| 19:30 – 21:00 | Dinner |
| 21:00 – 22:00 | Social Hour |

Tuesday, March 8, 2016

07:30 – 08:30 Breakfast

Session 3: Flash – Various (Experimental)

Session Chair: Antti Makinen, Office of Naval Research, USA

08:30 – 09:00 **Field and thermal factors in field-assisted consolidation of powder materials**
Eugene Olevsky, San Diego State University, USA

09:00 – 09:30 **Direct microwave sintering of gamma-alumina powder: Effect of alpha seeding and magnesia doping**
Paul Carry, SIMaP Laboratory, France

09:30 – 10:00 **Phase transformations in real time during flash**
Jean-Marie Lebrun, University of Colorado, USA

10:00 – 10:30 Coffee Break

10:30 – 11:00 **Role of defects in electric-field-assisted sintering**
Steve Hellberg, Naval Research Laboratory, USA

11:00 – 11:30 **Flash sintering of complex oxides**
Luis Perez-Maqueda, Materials Institute, Spain

11:30 – 12:00 Coffee Break

12:00 – 12:30 **Electric field-assisted flash sintering of fine-grained and high-permittivity $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ electroceramics**
Lilian M. Jesus, University of São Paulo, Brazil

12:30 – 13:00 **Flash sintering of ZnO , TiO_2 and other oxides: The origin of onset flash and effects of atmosphere, doping and particle size**
Jian Luo, University of California San Diego, USA

13:00 – 13:30 **Estimating ionic conductivity during flash sintering of 8ysz**
Daniel Marinha, Saint-Gobain CREE, France

13:30 – 14:30 Lunch

14:30 – 19:00 Afternoon guided excursion to the Templar Castle (Convento de Cristo), a UNESCO World Heritage Site

19:30 – 21:00 Dinner on your own

21:00 – 22:00 Social Hour

Wednesday, March 9, 2016

07:30 – 08:30 Breakfast

Session 4: Flash and SPS – Various

Session Chair: Lawrence Kabacoff, USA

08:30 – 09:00 **Flash sintering of glass containing alumina bodies**

Mattia Biesuz, University of Trento, Italy

09:00 – 09:30 **The influence of doping on flash sintering condition in $\text{SrTi}_{1-x}\text{Fe}_x\text{O}_{3-\delta}$**

Neta Shomrat, Technion, Israel

09:30 – 10:00 **Electric field effects on grain boundary formation and grain growth**

Klaus van Benthem, University of California Davis, USA

10:00 – 10:30 Coffee Break

10:30 – 11:00 **Flash obviates constrained sintering**

Rishi Raj, University of Colorado Boulder, USA

11:00 – 11:30 **Electrical field effects in spark plasma sintering of hyperstoichiometric UO_2**

Marco Cologna, European Commission, Joint Research Centre (JRC), Institute for Transuranium Elements (ITU), Germany

11:30 – 12:00 **Low-temperature spark plasma sintering of transparent ceramics by using SiC molding set**

Byung-Nam Kim, National Institute for Materials Science, Japan

12:00 – 12:30 **Electric current as a driving force for interphase growth in spark plasma sintered dielectric composites**

Catherine Elissalde, ICMCB-CNRS, France

12:30 – 13:00 **Discoloration of spark-plasma-sintered transparent MgAl_2O_4 spinel**

Koji Morita, National Institute for Materials Science, Japan

13:00 – 14:30 Lunch

Session 5: SPS – Various

Session Chair: Claude Estournès, Université de Toulouse; UPS, INP; Institut Carnot Cirimat, France

14:30 – 15:00 **Engineering of lightweight ceramic composites by spark plasma sintering**

Oleg Vasylykiv, National Institute for Materials Science, Japan

Wednesday, March 9, 2016 (continued)

- | | |
|---------------|---|
| 15:00 – 15:30 | Development of electric current activated/assisted sintering (ECAS/SPS)
Salvatore Grasso for Yoshio Sakka, National Institute for Materials Science,
Japan |
| 15:30 – 16:00 | Benefits of SPS sintering on microstructure and piezoelectric properties of KNN-based ceramics
Florian Jean, GREMAN, France |
| 16:00 – 16:30 | Coffee Break |
| 16:30 – 17:00 | Generating MgAl₂O₄ whiskers using carbothermic reactions and SPS/FAST
Anton Salomon, TU Bergakademie Freiberg, Germany |
| 17:00 – 17:30 | The mechanisms of field assisted sintering in metallic systems
Johannes Trapp, TU Dresden IfWW, Germany |
| 17:30 – 18:00 | Microscopic densification mechanisms of metallic systems by spark plasma sintering
Jean-Philippe Monchoux, Centre d'élaboration de matériaux et d'études
structurales, France |
| 18:00 – 18:30 | Coffee Break |
| 18:30 – 19:00 | Exploring length scale–property relationships in dense nanocrystalline materials
Javier Garay, University of California, San Diego, USA |
| 19:00 – 19:30 | SPS for chemical preparations
Ihor Veremchuk, Max Planck Institute for Chemical Physics of Solids, Germany |
| 19:30 – 20:00 | Ceramics of potassium sodium niobate by field–assisted sintering techniques: Spark plasma sintering versus spark plasma texturing
Paula Maria Vilarinho, University of Aveiro, Portugal |
| 20:00 – 21:00 | Dinner |
| 21:00 – 22:30 | Poster Session / Social Hour |

Thursday, March 10, 2016

07:30 – 08:30 Breakfast

Session 6: Techniques, Methods and Simulations–I

Session Chair: Michael Bakas, Army Research Office, USA

08:30 – 09:00 **Microstructure evolution in spark plasma sintered hafnium–tantalum carbides**

Ben Boesl, Florida International University, USA

09:00 – 09:30 **Consolidation behavior of bulk amorphous glasses and foils: The effect of current on devitrification kinetics**

Olivia A. Graeve, University of California, San Diego, USA

09:30 – 10:00 **Processing high strength low oxide and metal impurity ZrB₂ ceramics using boron carbide and spark plasma sintering**

Erica L. Corral, University of Arizona, USA

10:00 – 10:30 Coffee Break

10:30 – 11:00 **Hybrid heated FAST/SPS with additional voltage support**

Jan Raethel, Fraunhofer IKTS, Dresden, Germany

11:00 – 11:30 **A dynamic bifurcation criterion for thermal runaway during the flash sintering of ceramics**

Joao Gustavo Pereira da Silva, TUHH, Germany

11:30 – 12:00 Coffee Break

12:00 – 12:30 **Hybrid heated FAST/SPS with additional voltage support**

Jan Raethel, Fraunhofer IKTS, Dresden, Germany

12:30 – 14:00 Lunch

Session 7: Techniques, Methods and Simulations–II

Session Chair: Olivier Guillon, Forschungszentrum Jülich GmbH, Germany

14:00 – 14:30 **Field effects during consolidation of metallic powders**

Brandon McWilliams, US Army Research Laboratory, USA

14:30 – 15:00 **Microwave and flash processing of functional materials: Are there (m)any similarities?**

Bala Vaidhyanathan, Loughborough University, United Kingdom

15:00 – 15:30 **Flash sintering: New opportunities**

Salvatore Grasso, Queen Mary University of London (QMUL), United Kingdom

Thursday, March 10, 2016 (continued)

- | | |
|---------------|---|
| 15:30 – 16:00 | Ceramics sintering and shaping using the electrical field assisted sintering method
Amiya Mukherjee, University of California, USA |
| 16:00 – 16:30 | Coffee Break |
| 16:30 – 17:00 | Spark plasma sintering: Comparison between a fully coupled process numerical simulation and experimental data
David Martins, CEMEF / CIRIMAT / SAFRAN, France |
| 17:00 – 17:30 | Growing larger: Scaling up during spark plasma sintering of high-temperature ceramics
Oleg Vasykiv, National Institute for Materials Science, Japan |
| 17:30 – 18:00 | Energy coupled to matter for field-assisted processing
Raymond Brennan, U.S. Army Research Laboratory, USA |
| 18:00 – 18:30 | Coffee Break |
| 18:30 – 19:00 | Energy coupled to matter for field-assisted processing
Raymond Brennan, U.S. Army Research Laboratory, USA |
| 19:00 – 19:30 | Field assisted sintering: Challenges in scale-up from buttons to body armor
Christopher D. Haines, US Army ARDEC, USA |
| 19:30 – 21:30 | Banquet followed by Social Hour |

Friday, March 11, 2016

07:30 – 08:30 Breakfast

Session 8: Innovative Materials

Session Chair: Rolf Janssen, TUHH, Germany

08:30 – 09:00 **Modelling and FEM simulation of electric field assisted sintering of tungsten carbide (WC)**

Sree Koundinya Sistla, RWTH–Aachen University, Germany

09:00 – 09:30 **Spark plasma sintering: From the thermal gradient to advanced ceramic composites**

Dmytro Demirskyi, Nanyang Technological University, Singapore

09:30 – 10:00 **Densification of dense nano crystalline zinc oxide under electric field**

Olivier Guillon, Forschungszentrum Jülich GmbH, Germany

10:00 – 10:30 Coffee Break

10:30 – 11:00 **Features of grain growth and grain boundary formation under microwave and spark plasma sintering conditions**

Andrey Ragulya, Institute for Problems of Materials Science (IPMS), Ukraine

11:00 – 11:30 **Fabrication of a vitreous porcelain by conventional sintering and spark plasma sintering**

Wirat Lerdprom, Imperial College London, United Kingdom

11:30 – 12:00 **Application of microwave energy to consolidate titanium powder**

Christopher Haines, US Army ARDEC, USA

12:00 – 12:30 **Modification of the interdiffusion process in the Fe–Al system by SPS and field assisted sintering**

Hanka Becker, Technical University Bergakademie Freiberg, Germany

12:30 – 13:00 **Application of steel as an alternative tool material for field assisted sintering in SPA**

Alexander Laptev, Forschungszentrum Jülich GmbH, Germany

13:00 – 13:30 **Abnormal grain growth in pressure assisted sintering of BaLa₄Ti₄O₁₅**

Ana Senos, University of Aveiro/ CICECO, Portugal

13:30 Lunch and Departure

Poster Session

Session Chair: Rolf Janssen, TUHH, Germany

1. **Flash sintering of SrTiO₃**
Fabian Lemke, KIT, Germany
2. **Flash sintering of TCP bioceramics: Effect of particle size and influence on $\beta \rightarrow \alpha$ transition**
Matteo Frasnelli, DII - University of Trento, Italy
3. **FAST sintering of alumina, spinel and yttria-stabilized zirconia three-phase composites**
David Kok, University of California, Irvine, USA
- 4.
5. **Fast one-step synthesis and sintering of materials promoted by electric fields**
Lilian M. Jesus, University of São Paulo, Brazil
- 6.
- 7.
8. **Observations on Flash Sintering of Uranium Dioxide**
Kenneth J. McClellan, Los Alamos National Laboratory, USA
9. **Microstructure and mechanical properties of Spark Plasma Sintered tungsten-copper-zinc composites**
Thabiso Langa, Tshwane University of Technology, South Africa
10. **Self-organized structure in current-activated pressure-assisted densification (CAPAD)**
Sebastian Angst, University of Duisburg-Essen, German
- 11.
- 12.
- 13.
- 14.
15. **Growth behavior of faceted Na_{1/2}Bi_{1/2}TiO₃-BaTiO₃ grains in single and two-step sintering in support for the microstructural evolution principle**
Seok-Young Ko, Korea Advanced Institute of Science and Technology (KAIST), South Korea